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Linking to Full Text in Scholarly Journals: Here a Link, There a Link, Everywhere a Link

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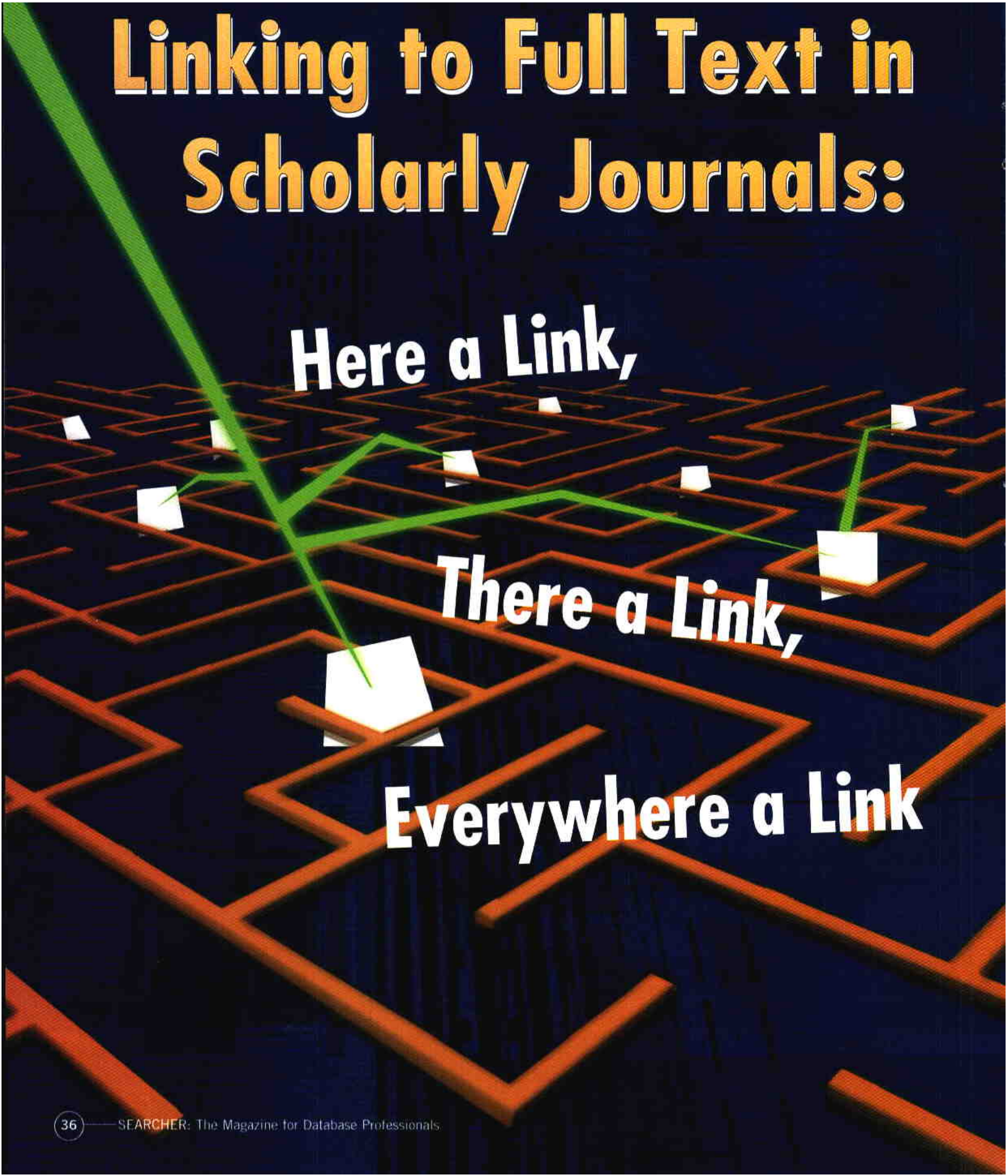

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The holy grail for content providers and users alike is a seamless, integrated, transparent network that allows searchers to link quickly and painlessly to any document they seek. Users want easy access to full text, and content providers are continually breaking new ground in their attempts to give users what they want. This creates an exciting variety of options, but a variety that can confuse both information professionals and end users. Then too, when trying to find the full text of journal articles, the promises and advertisements of aggregators and publishers often seem inflated.

According to an April 2000 *Library Journal* article, "Pushing Toward More Affordable Access," electronic journal publishing generally falls into two categories: "e-journal and full-text aggregation."[1] E-journals are offered by subscription from publishers via their Web sites; full-text aggregation involves publishers handing their material over to an aggregator, who then houses the full text. To complicate matters, the publisher may also be an aggregator. Moreover, aggregators, whether supported by primary or secondary publishers, may choose to house the full text on internal servers or link to the full text housed elsewhere. Therefore, access to the full text involves linking: linking between aggregators and publishers; linking between primary publishers; and linking between secondary publishers and primary publishers. Linking adds another dimension to the increasingly complex landscape of electronic publishing.

There are myriad approaches used to link full text for journal articles and other full texts. Linkages can include those among aggregators, primary publishers, and government aggregators, as well as those among citations appearing in research articles, e-print or preprint services, and other Web resources. These links make research faster and easier for experienced searchers, but for the uninitiated can represent a maze of confusion as they face complex, not yet fully standardized, linking practices.

To further muddy the water, full texts are available from multiple sources and in multiple formats. For example, the number of periodicals listed in *Fulltext Sources Online* has grown from about 4,400 in 1993 to 13,094 in July 2000 (up from about 8,900 in May 1999 and 7,600 in 1997). Additionally, the number of titles in the Association of Research Libraries' *Directory of Electronic Journals, Newsletters, and Academic Discussion Lists* (7th ed., 1998) has grown from only 26 in 1991 to nearly 2,500 in 1997.[2]

Elements of Linking

In evaluating linking to full text, one must consider three general elements:

The type of link being provided: Are the links internal, contained within one service? Or external, connecting records or documents among two or more services? Can the links connect records to local holdings?

The format in which the full text is delivered: Portable Document Format (PDF) or plain ASCII text? HTML or SGML?

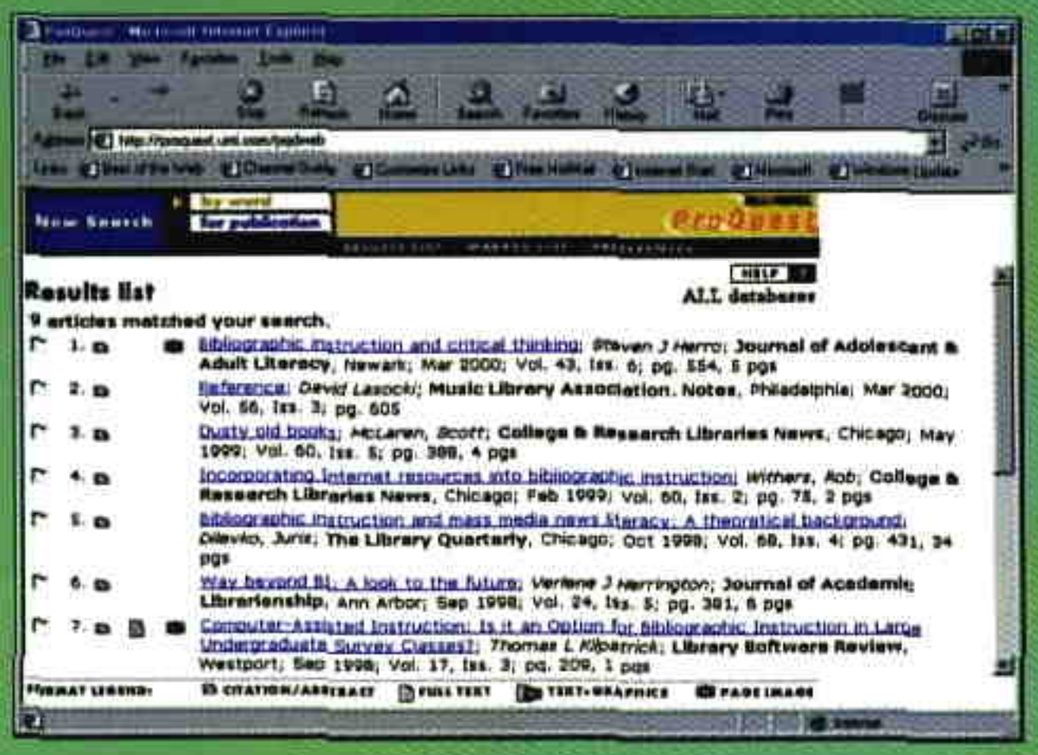
The identity of who provides the links and/or the full text: A primary or secondary publisher? Or a mixture of the two?

Each of these three fundamental elements needs examination on its own and in conjunction with its two counterparts. Information professionals must sort through all the options for full text in order to provide their constituents with the relative best option.

Types of Linking

Types of links, format options for full text, and link ownership, as well as appropriate copy issues, need to be evaluated and understood when choosing one of the many linking options. Generally, there are two types of reference linking[3]: internal and external. *Internal linking* is contained within one service, as in linkage within an aggregator, such as Ovid or OCLC. Users don't have to select an "appropriate copy" from among choices because they have access to the front door, so to speak, that is, a licensed copy acquired by the institution. But it is with *external linking*, as in the links within PubMed to publisher Web sites or the new CrossRef initiative, that the appropriate copy problem emerges. As a warning, the lines continue to

FirstSearch



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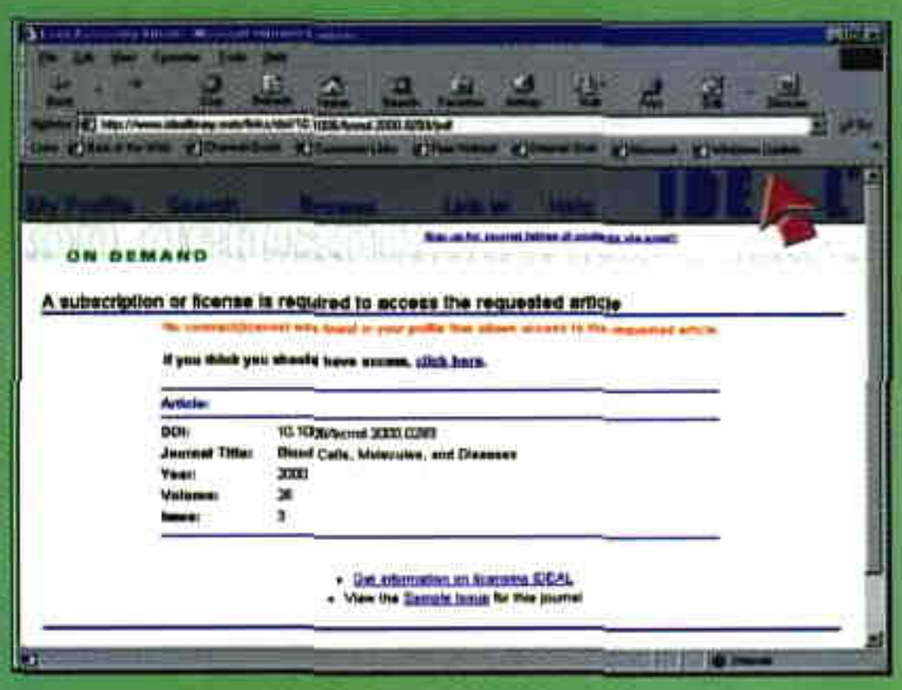
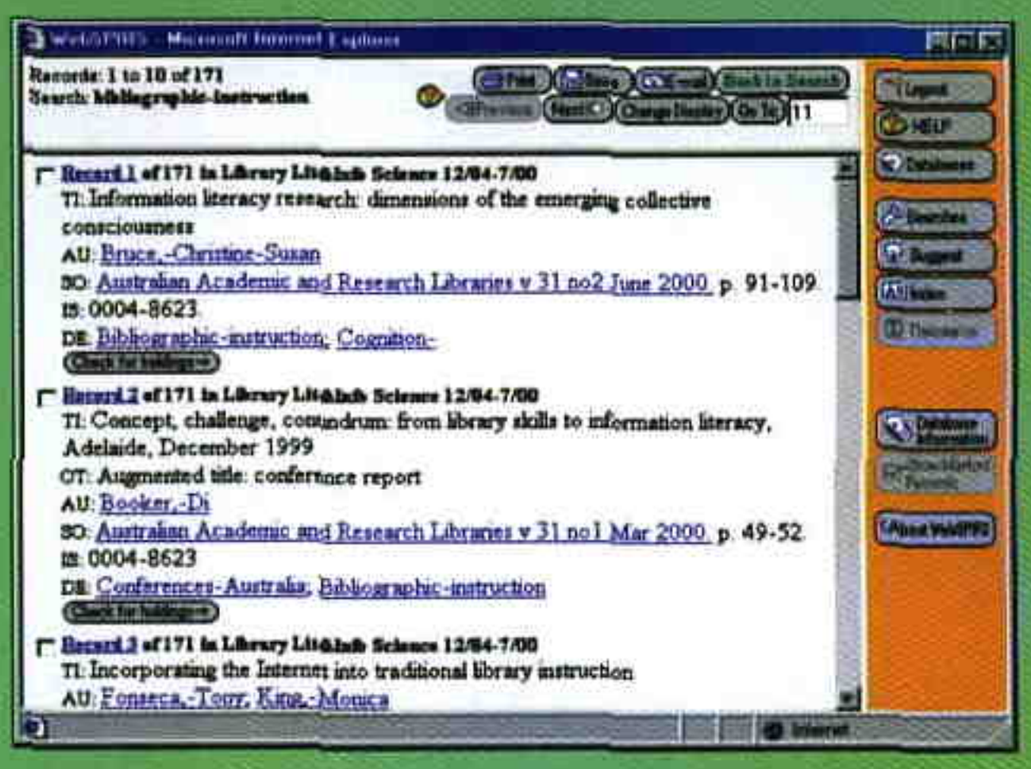


IDEAL



WebSPRS

blur between traditional aggregator and primary publisher. ElsevierScience, via its ScienceDirect, is now publisher, aggregator, and bibliographic database provider (e.g., Embase or *Excerpta Medica*, Compendex or *Engineering Index*). Internal or external linking is no longer exclusive to either aggregators or publishers.

Aggregators and publishers use both internal and external linking, so both worry about the best way to maintain linkages between online services. As is often the case, standards are the best way to insure across-the-board consistency. The current consensus is that using URLs alone as surrogates for reference links is troublesome because URLs merely designate a manifestation, or an instance, of an article, but do not allow for a persistent identifier, independent of location.

With URLs dubious, several linking options have been proposed and come into use, some of which address the appropriate copy issue, and some of which don't. One linking option is the model of a unique identifier for each article (created from metadata), for example, the Digital Object Identifier (DOI), developed by the International DOI Federation [http://www.doi.org] for the publishing industry. According to the International DOI Federation, the DOI is "both a persistent identifier and a system which processes that identifier on the Internet to deliver services." DOIs provide the dual advantages of being persistent and unique. [For more information about DOIs, see http://www.doi.org/faq.html.] Linking agreements among services govern the use of DOIs or other link protocols.

More and more publishers have begun realizing the value of having their material available via reference links or out-and-out housed on an aggregator's server. The following discussion of linking practices for full text access addresses both aggregators and publishers in examples of both internal and external linking. But reader, beware: Most services these days employ

both internal and external linking to some degree.

Internal Linking

Internal linking is, again, contained within one service. Links move the user among documents and records housed together. Internal linking benefits the information professional because it allows them to negotiate licensing and other similar matters with one service. Often, the service itself contracts with hundreds of publishers, thereby taking the burden off the information professional. Internal linking benefits users, because they only have to interact with one protocol and one interface, thus lowering the learning curve. Services that provide internal linking, such as the ProQuest Research Library, offer one-stop shopping, and ultimately that convenience factor can insure their success.

Other services such as SilverPlatter and Ebsco also offer a type of "one-stop shopping" with one interface and one service for multiple-publisher, multiple-database subscription and licensing agreements. The key difference is that these services use both internal and external linking, with some links taking users to material hosted in-house and some links taking users to material hosted elsewhere. For instance, EBSCO Online is a Web-based service that offers a single interface for access to full text. The full text is housed either at EBSCO or at a publisher's Web site via access agreements, such as the one EBSCO has with HighWire Press.

Aggregators

Aggregators represent a significant portion of the services currently using internal linking. One method of internal linking is from a bibliographic database to the full text of the article held on the same service. For instance, OCLC's FirstSearch [http://www.oclc.org] has integrated its bibliographic databases with its Electronic Collections Online (ECO). Links go from the records in the bibliographic databases to the full text of articles in ECO. (As of August 2000, both the older version of FirstSearch and the stand-alone version of ECO were discontinued.) Links do not take the searcher outside the OCLC environment. The full text of articles in ECO are held on an OCLC server, just as the bibliographic database records are held on an OCLC server. Available formats for the full text include PDF, HTML, and Catchword RealPage.

Ovid [http://www.ovid.com] offers another example of internal linking with links between its bibliographic databases and the full text of articles available via Journals@Ovid, Ovid's aggregated fully SGML database of hundreds of scientific, technical, and medical journals. Again, depending on license agreements with Ovid, the searcher seamlessly moves from a link on a bibliographic record to the full text, never leaving the Ovid service. According to Ovid, "Journals@Ovid features over 7.5 million links from references in its 700,000 articles to citations in Ovid bibliographic databases and the full text of other Journals@Ovid articles." With Journals@Ovid, users can link from bibliographic databases to full text, from full text to licensed bibliographic databases (e.g., from Journals@Ovid to BIOSIS citations), and from full text to full text via footnotes or endnotes connecting to full text. Other aggregators employing similar types of internal linking include EBSCO, The Gale Group's InfoTrac, and Bell and Howell's ProQuest. However, when evaluating full text options, remember that many services use both internal and external linking.

Another example of internal full-text linking comes from the Web aggregator, Northern Light [http://www.nothernlight.com]. Currently, Northern Light has 21 million individual full-text documents in the Special Collection, most of which date back to January 1995. The full text of articles is kept internally on the Northern Light server; users never move from the Northern Light service to another site on the Web.

Primary Publishers

Primary publishers also employ internal linking through their own online services. Many major STM publishers offer their own journals electronically, e.g., Elsevier's ScienceDirect [http://www.sciencedirect.com], Springer-Verlag's LINK [http://link.springer.de], Academic Press' IDEAL [http://www.idealibrary.com], and Wiley InterScience [http://www3.interscience.wiley.com]. Through subscriptions, ScienceDirect offers the full text of more than 1,000 Elsevier Science journals from January 1996 forward. Format options include HTML and PDF. Additionally, ScienceDirect offers licensing of several databases, including Ei Compendex and EMBASE, with incorporated linking from these bibliographic databases to its full-text article collection.

Approximately 400 of the journals published by the International Springer publishing group are available via LINK, its information service created for the Internet. According to Springer, LINK is not exclusive to Springer journals, since other publishers offer journals within LINK. The LINK service divides journals into Online Libraries, such as chemical sciences, computer science, or life sciences. Some of LINK's features are free, including access to tables of contents, article abstracts, and full-text searches of the articles. The complete articles, however, are only available to subscribers. Formats vary from journal to journal and include PDF, PostScript, Tex, and HTML, with PDF the most widely used. Springer also has a service called OnlineFirst, in which articles appear electronically before their print counterparts. [For more information about OnlineFirst and a list of journals using the service, visit http://link.springer.de/doi/online-first.htm.]

Academic Press, via its online journal library, International Digital Electronic Access Library (IDEAL), contains over 167,000 articles from nearly

250 journals. It offers the full text of journals published by Academic Press, W.B. Saunders, and Churchill Livingstone, all Harcourt International imprints. The articles display as PDF files. Authorized users can acquire the full text of journals from John Wiley & Sons via Wiley InterScience, where users can access tables of contents and abstracts for some journals for free. Wiley InterScience full text for subscribers includes formats such as PDF or HTML. As an example, Wiley offers the *Journal of the American Society for Information Science* (ASIS) goes to subscribers either as a print or electronic version (or both versions for an extra fee).

Both a publisher and an aggregator, the American Institute of Physics' Online Journal Publishing Service (OJPS) [http://ojps.aip.org/] supplies a different example of internal linking. The full text of journals published by AIP, as well as other organizations and publishers, are housed within OJPS and searchable via its interface. AIP and the Naval Research Laboratory (NRL) completed a project to expand the full text available from OJPS, converting journals such as *Journal of Applied Physics*, *Journal of Chemical Physics*, *Journal of Mathematical Physics*, and more. Among others, the American Society of Mechanical Engineers International uses OJPS as the platform to host its 17 journals. According to AIP, OJPS offers free tables of contents and abstracts from 95 journals and full text in HTML, PDF, and PostScript formats for subscribers. Document delivery is available for non-subscribers.

As a final example, HighWire Press [http://highwire.stanford.edu] does not fit neatly into either category of aggregator or publisher. A project of the Stanford University Library, HighWire Press assists in the online publication of the Web versions of scholarly journals in biomedicine and other disciplines, offering access to free online full-text articles (approximately 170,000 articles as of mid-September) via internal links *and* external links. External links may take users to publisher Web sites, where the free full text varies widely from journal to journal and includes access to back issues, trial periods, and some entirely free sites. HighWire Press also provides links to pay-for-access sites via pay-per-article and its Site Pass, which pays for access to all articles for a predetermined time period (24 hours, 30 days, etc.). Finally, institutions and consortia can arrange subscriptions and/or special pricing for access to full text. Full-text formats include HTML and PDF.

Government Aggregators

Government-supported agencies and aggregators also utilize internal linking. A prime example is PubMed Central [http://pubmedcentral.nih.gov], which the National Institutes of Health (NIH) envisions as a "barrier-free NIH repository for peer-reviewed primary research reports in the life sciences." Although under fire from commercial publishers, PubMed Central began accepting journal articles in January 2000. Each journal has a link that indicates the status of the full-text coverage. The full text of the articles can be viewed either as HTML through a Web browser or as downloadable PDFs. PubMed Central hopes to provide direct links from PubMed search results of the Medline database to the full-text articles in PubMed Central. Currently, PubMed Central article reference citations link to PubMed abstracts. All input is SGML-tagged.

Unlike PubMed Central, which is a public initiative that makes some material already published elsewhere available for free, BioMed Central [http://www.biomedcentral.com] is a commercial publishing house. PubMed Central accepts and archives materials only from primary publishers; BioMed Central accepts original research directly from the author and publishes the research on the Web, in addition to hosting some journals. According to BioMed Central, "All research articles will be made immediately freely available through PubMed Central, as well as through BioMed Central."

The unique, and controversial, characteristic of both PubMed Central and BioMed Central is the fact that both distribute all material for free. The Freedom of Information Conference, held July 6-7, 2000, discussed the implications of such a free dissemination of primary research literature. [For more information about The Freedom of Information Conference, including articles and speeches, go to http://www.biomedcentral.com/info/information.asp.] Some publishers feel PubMed Central will be unfair to government competition in journal distribution and publishing.

External Linking

The linking models mentioned above all involve internal links that move the user from one spot to another within the same online service. The service determines and designs source and target link protocols and searchers need not worry about the protocols of other online services. However, online services do not function as islands unto themselves. By the very nature of a hyperlinked world, online services interact with one another. External linking takes the searcher out of a current service to access additional services or content. A link may take the user from a bibliographic record or full-text article to a remote publisher's Web site or to another full-text aggregator. One-stop shopping is still available, but the links to full text do not always travel within one service

With external reference linking, the issues of how best to link and of appropriate copy become acute. Also, some types of external linking, such as linking to a publisher's Web site, have difficulties dealing with a situation in which each publisher controls the format and availability of full text. With more variety comes more options, but the options may be good or bad.

Aggregators

Primary publishers were not the first to provide external links to scholarly journal articles. Aggregators, such as SilverPlatter, pioneered external linking. For example, SilverPlatter's SilverLinker [http://www.silverplatter.com/silverlinker/] links from bibliographic databases on SilverPlatter's Web service to full-text journal articles housed elsewhere. SilverLinker takes the user from a bibliographic record within a SilverPlatter database directly to the article, hosted on an outside service, via article-specific URLs. In other words, the user goes directly to the article, not to the top level of the electronic journal's Web site. The full text of the article only becomes available, however, if the user or the user's organization has a subscription to that journal. The article-level URL links are maintained in the SilverLinker database and updated weekly.

SilverPlatter has numerous agreements with publishers and aggregators, for example with Elsevier's ScienceDirect, the American Institute of Physics' Online Journal Publishing Service, Annual Reviews, MCB University Press, the Institution of Electrical Engineers, Academic Press, Catchword, Springer-Verlag, SwetsNet, MCB University Press, FRANCIS, and Project Muse. Additionally, SilverPlatter and its Electronic Reference Library allow libraries to link from SilverPlatter databases to their holdings, via a link from a record to a Web-compatible online catalog that directs users to the appropriate copy.

Such linking does present problems for libraries, however. Gayle Baker, Electronic Services Coordinator for the University of Tennessee Libraries (UTL), commented on one snag. UTL pays for its access to SilverPlatter databases according to a contracted number of simultaneous users. If a user moves via external links from a SilverPlatter database to a full-text article housed elsewhere or moves via external links to the library's holdings, then the user often spends time perusing the article online. With the user still logged into SilverPlatter as one of UTL's simultaneous users, that may block someone else from gaining access to the system. So UTL chose to avoid the problem by linking from SilverPlatter databases to local holdings.[4]

Ovid has also joined the game of external full-text linking with its recently released OpenLinks software, an add-on for Ovid Web Gateway Version 4.1.0. The software allows users to incorporate links from records in Ovid bibliographic databases to full-text journal articles located on publisher Web sites. For OpenLinks, Ovid has linking agreements with several publishers, including Academic Press (IDEAL), the American Institute of Physics, Catchword, Karger, Project Muse, Royal Society of Chemistry, and Springer LINK. OpenLinks resembles SilverLinker by taking the user directly to the articles hosted on external publisher sites. However, OpenLinks differs from SilverLinker in that links are created on the spot from information (or metadata) contained in the Ovid bibliographic records.

The difference between SilverPlatter's database approach and Ovid's "just-in-time" approach is the difference between static and dynamic linking. There are many models for static linking, but generally links are precomputed. Dynamic linking (such as SFX), on the other hand, creates links on the spot using metadata. Aggregators, such as Ovid, may use both types of linking.[5]

OCLC offers a different type of external linking via its consolidation tool, WebExpress [http://www.oclc.org/webexpress/]. WebExpress allows the integration of OCLC and non-OCLC services, including library holdings, all accessible through one interface. The service also allows Web-based administration and local customization via links to resources.

One of the largest aggregators using external linking resulted from the March 2000 merger between Swets Subscription Service and Blackwell's Information Service, Swets Blackwell [http://www.swetsblackwell.com]. Swets Blackwell has a database of more than 250,000 titles. Its service Swetsnet*Navigator* [http://www.swetsnetnavigator.nl] offers one interface to access full text, tables of contents, and abstracts from more than 3,300 journals from 65 publishers. Information professionals can create links from online catalogs based on ISSN, volume, issue, and page number. Also, Swets*Navigator* offers predefined links from secondary databases via agreements with CSA, Dialog, MDL, SilverPlatter, and H.W. Wilson. PDF is the most common format for full text, although some publishers use Catchword RealPage.

The Institute for Scientific Information's (ISI) Web of Science [http://www.isinet.com/] is another aggregator using external full-text links. Links are available, though not automatic, between Web of Science records to full-text counterparts at both publisher and aggregator Web sites. Additionally, some full-text articles have links inward from the full text to the Web of Science record. According to ISI, "The vision of this linking is to offer bi-directional links, which allow users to link from records in the Web of Science to corresponding full-text articles and from article references appearing in full text to records in the Web of Science." Publishers with whom ISI has linking agreements include Academic Press, American Institute of Physics, Blackwell Science, Catchword, Ltd., Cambridge University Press, HighWire Press, John Hopkins University, John Wiley & Sons, Karger Kluwer Academic Publishers, OCLC, Royal Society of Chemistry, SIAM, Springer-Verlag, and Stockton Press. [For more information about linking at ISI, visit http://www.isinet.com/isilinks/.]

A final example of aggregators taking advantage of external linking is the provision of reference links by

Chemical Abstracts Service (CAS), a division of the American Chemical Society, through the ChemPort Connection service. CAS provides several ChemPort publishers, including Academic Press/IDEAL, the American Institute of Physics, Royal Society of Chemistry, and Springer-Verlag, with reference links. According to Eric Shively of CAS, these links connect "references in publishers' electronic journals to CAS database records or the original full-text articles on the Web." The full text is a mixture of free and priced material, and CAS recently added links to full-text patents.

The CrossRef initiative is one of the newest ways primary publishers link to one another's publications.

Primary Publishers

The CrossRef initiative is one of the newest ways primary publishers link to one another's publications. The new Publishers International Linking Association (PILA), a nonprofit membership organization, began in the first quarter of 2000, and went operational with the CrossRef service [http://www.crossref.org] in June 2000. PILA members include publishers of original or primary scholarly material as well as secondary services that link to that material. Participating publishers currently include such giants as Elsevier Science, Harcourt (Academic Press), Springer-Verlag, John Wiley & Sons, and Blackwell Science.

CrossRef has no visible interface. The service enables links from article references or citations to the cited article, usually hosted at the publisher's Web site. Once users arrive at the publisher's Web site, the publisher determines access to the full text. For instance, if a subscription is not held, access alternatives vary from publisher to publisher, but may include options such as pay per article. The links within CrossRef rely on Digital Object Identifiers from the International DOI Foundation [http://www.doi.org] and the DOI-X metadata standard to ensure permanent links. The first links went live on June 5, 2000.

Speculation has it that the CrossRef initiative was a publisher-fueled reaction to PubMed Central and HighWire Press. Open access to scholarly work published on the Web threatens publishers, and to a lesser extent, aggregators. Preprint servers are the most common open access distributors, and examples include the Los Alamos National Laboratory physics archive [http://xxx.lanl.gov/] and Elsevier's chemistry preprint service [http://preprint.chemweb.com]. [For a discussion of "e-prints," read Tomaiuolo and Packer's article, "Preprint Servers: Pushing the Envelope of Electronic Scholarly Publishing," in the October 2000 issue of Searcher.]

Whether fueled by free distribution or by economics, CrossRef is only one of the newest ways publishers link. For example, ScienceDirect provides access to the full text of much more than just Elsevier-published journals and thus employs both internal and external linking. ScienceDirect includes the full text of journals from scholarly societies and other publishers, including the American Institute of Chemical Engineers, CRC Press, ASM International, Royal Society of Medicine, International Press, and TMS, and links to 174 Academic Press titles. According to its Web site, ScienceDirect has negotiations underway with other publishers. Additionally, ScienceDirect has agreements with scholarly databases, such as SilverPlatter, and indexing and abstracting services, such as BIOSIS, to create links between these services and the full text of ScienceDirect's articles. ScienceDirect is also involved in the CrossRef initiative. Finally, ScienceDirect and SwetsBlackwell have a linking agreement for U.K. universities which participate in the National Electronic Site License Initiative [NESLI, http://www.nesli.ac.uk/].

ScienceDirect's external linking is maintained by the ScienceDirect Gateway, which enables linking between electronic distribution platforms. According to the ScienceDirect Gateway Web site [http://gatewaylink.sciencedirect.com/gw_welcome.htm], as of January 2000, the linking technology is primarily CrossRef. However, not all linking will utilize the CrossRef technology. For example, inward linking to ScienceDirect by SilverPlatter will utilize SilverLinker technology.

Inward and outward linking partnerships from abstracts and cited references on ScienceDirect and to ScienceDirect full text include Academic Press (IDEAL), Blackwell Science (Synergy), John Wiley & Sons (InterScience), and Springer-Verlag (LINK), all via CrossRef.

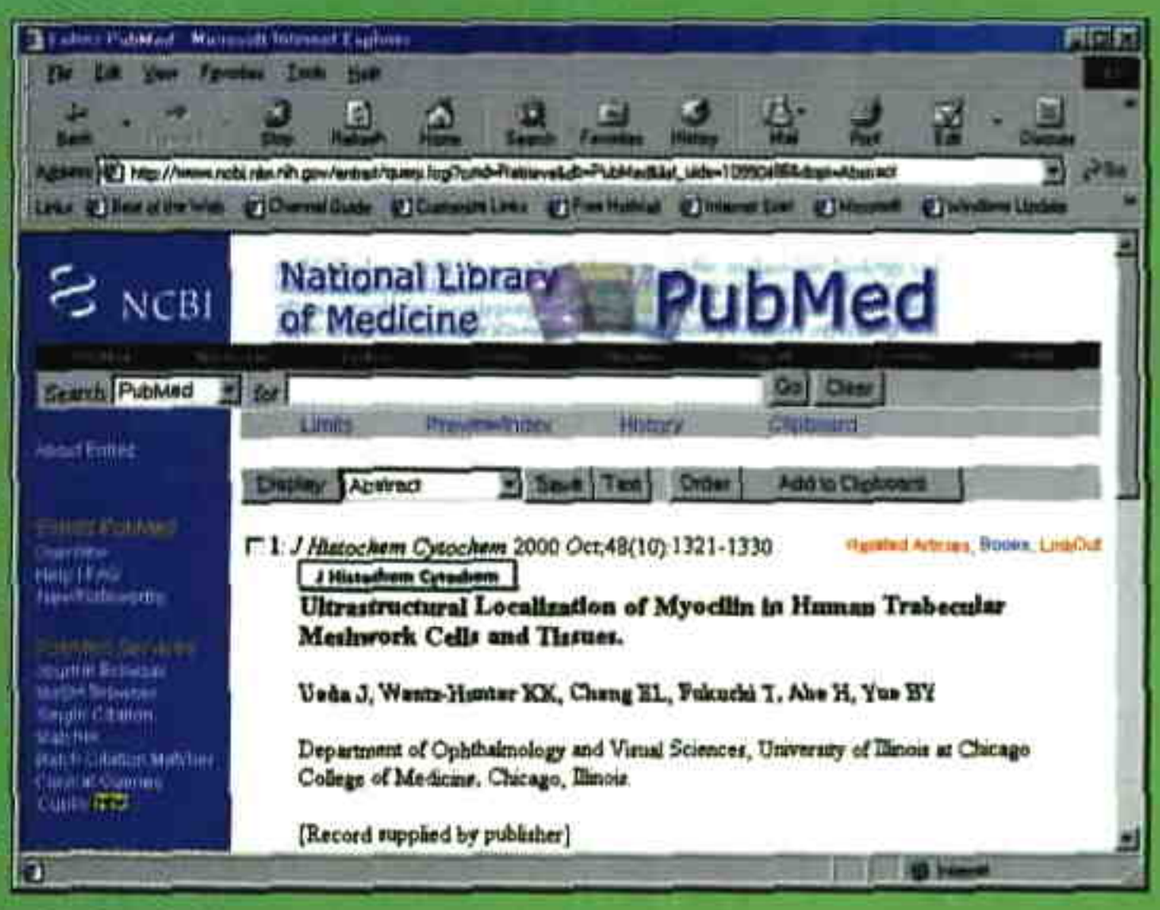
Additionally, through recent agreements, a variety of inward and outward links (based on subscriptions) is available through agreements with the American Institute of Physics, the American Physical Society (OJPS), and the American Mathematical Society (MathSciNet Math Reviews). Other inward links to subscribed full text on ScienceDirect are available from BioMedNet, Cambridge Scientific Abstracts, Engineering Information, ISI's Web of Science, Ingenta (BIDS/NESLI, UK only), Neuroscion, PubMed, and SilverPlatter. Informa-

tion about inward and outward linking with ScienceDirect is available at http://gatewaylink.sciencedirect.com/featureslead.htm.

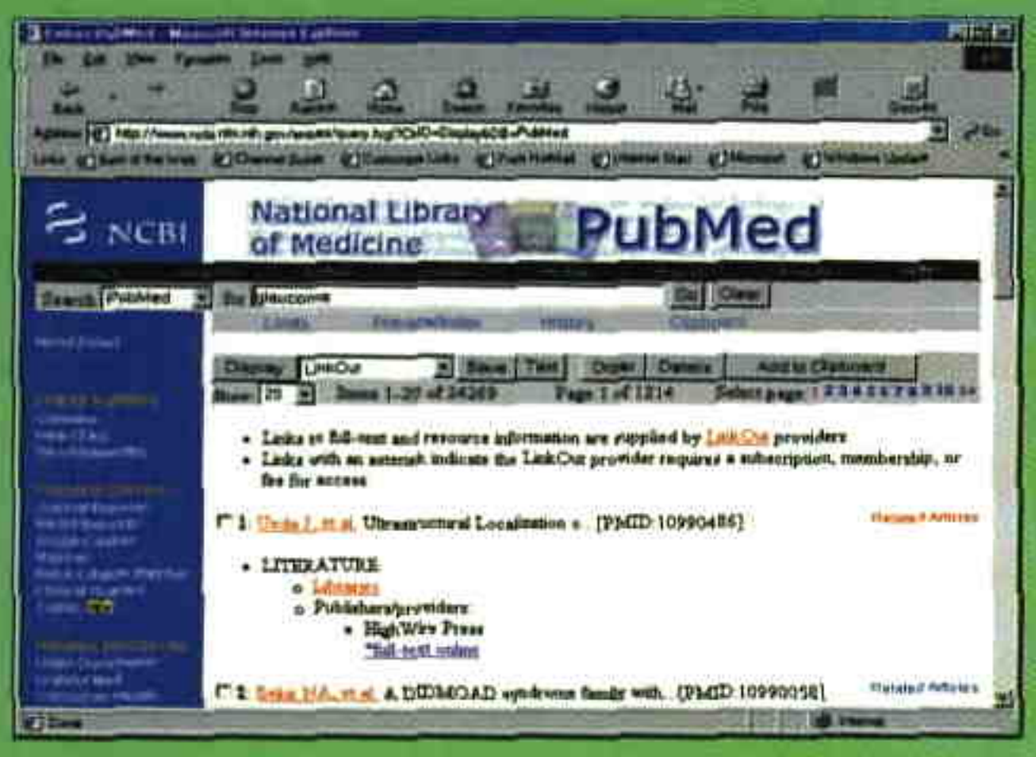
Government Aggregators

Government-supported agencies and aggregators also employ external linking. Two primary examples are PubMed and PubSCIENCE. PubMed [http://www.ncbi.nlm.nih.gov/PubMed/], from the National Library of Medicine's (NLM) search service, provides access to citations in MEDLINE, PreMEDLINE, and related databases, with external links to participating online journals. Access to the full text of articles from citations in PubMed appears in two distinct ways: via the LinkOut feature within PubMed and via registration with the Loansome Doc document delivery service.

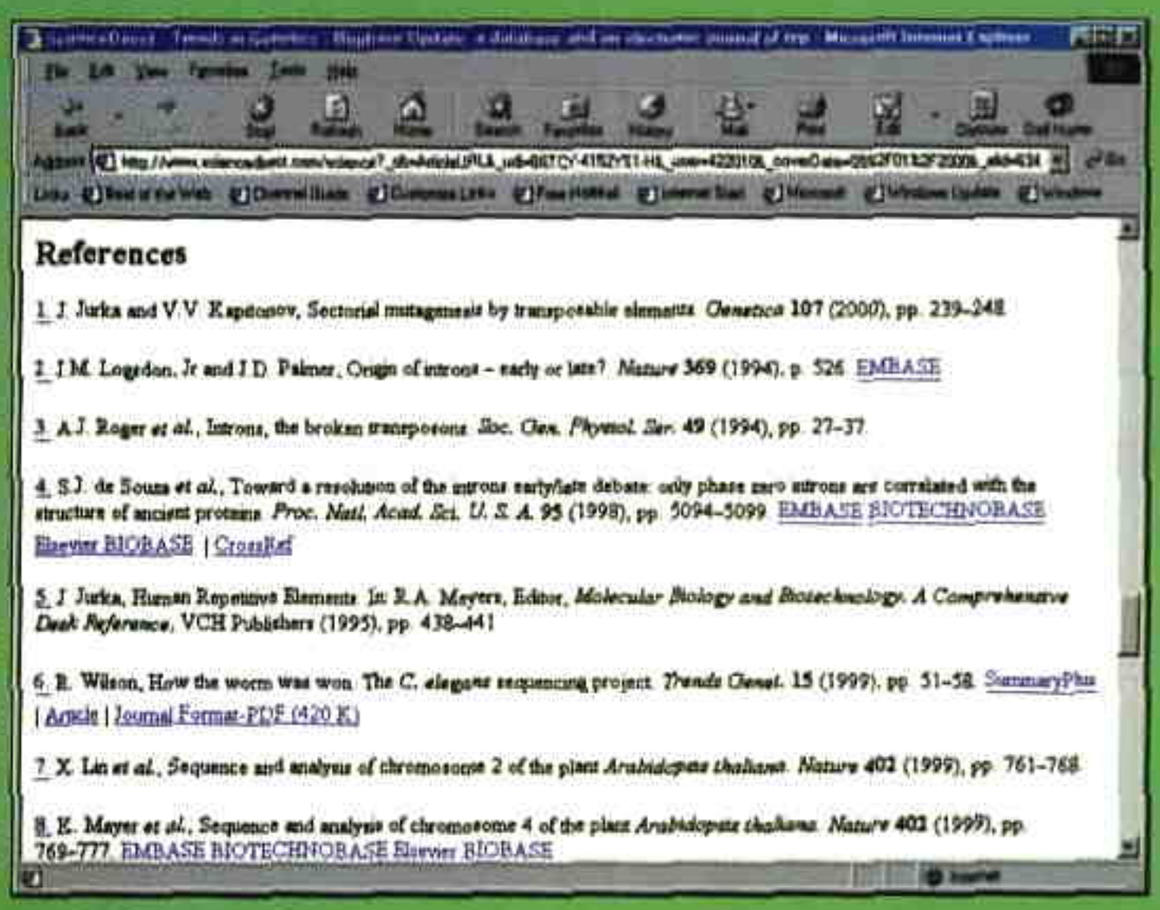
Access to full text through the LinkOut feature is limited, however, as publishers and other external data providers are responsible for providing NLM with the links for each article. When a query is entered in PubMed and a record retrieved, the user is presented with the possibility of three



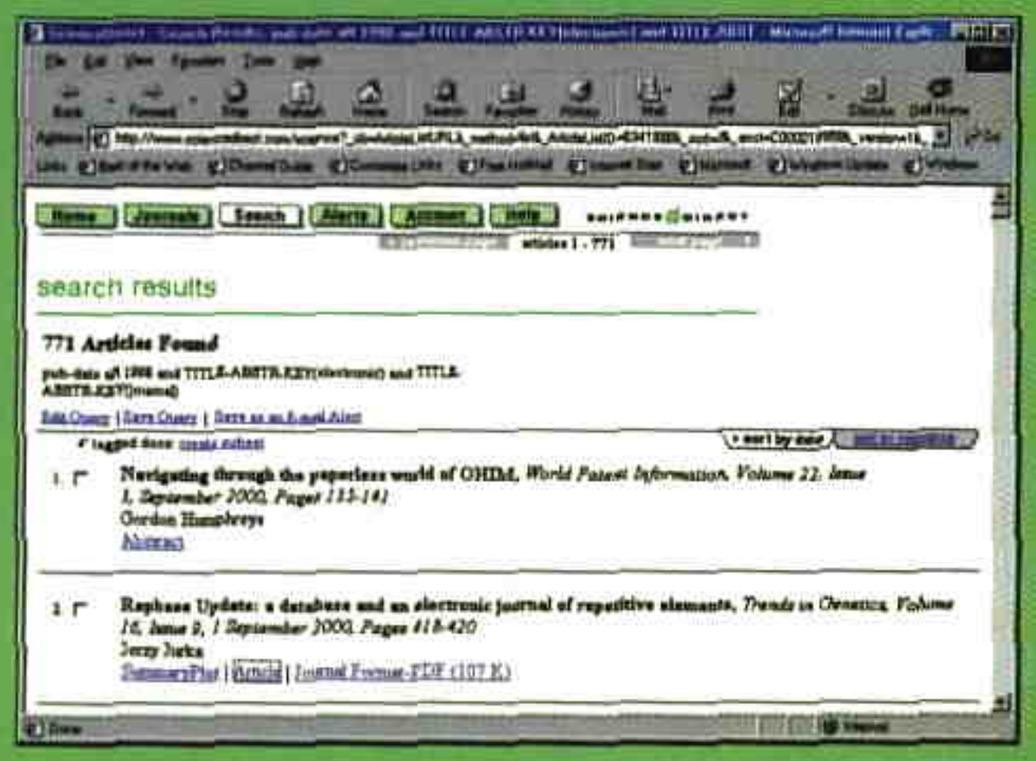
NLM's PubMed



PubMed — continued



ScienceDirect



ScienceDirect — continued

The "Appropriate Copy" Problem

Another issue often associated with linking to full text is the "Appropriate Copy" problem, discussed at length in two meetings held in 1999 by the National Information Standards Organization (NISO), the Digital Library Federation (DLF), the National Federation of Abstracting and Indexing Services (NFAIS), and the Society of Scholarly Publishers (SSP).[6] The appropriate copy problem involves the multiple availability of the same full-text article from several sources. First, aggregators such as Ovid or OCLC overlap in their coverage. Second, electronic publishers such as Elsevier make journal articles available within their own full-text online services and for local loading. And third, e-print or preprint services such as the Los Alamos National Laboratory [http://xxx.lanl.gov] and PubMed Central host articles (often published elsewhere) in a preprint form on their servers, often free of charge.[7] Another example of such a free preprint service is the one hosted by Elsevier on its ChemWeb site [http://preprint.chemweb.com].

The appropriate copy problem becomes acute because libraries and other organizations often only provide licensed access via one or more of these avenues. Hence, librarians and information professionals want their user communities directed to the appropriate copy as defined by their organizational affiliation.[8] One solution to the appropriate copy problem is linking to a local library's holdings; many services, such as SilverPlatter, offer this option. Other solutions include new advances in linking technology.

One such new advance in linking technology is the SFX framework, developed by Herbert Van de Sompel from the University of Ghent in Belgium. SFX server software is now being marketed by Ex Libris, Inc. [http://www.sfxit.com]. According to Ex Libris, SFX allows for context-sensitive linking; the target of the link depends on the user-affiliated institution's collection. SFX works by providers of information resources installing a "hook" so that servers can dynamically select the link's target. Van de Sompel's research is outlined in three articles in D-Lib Magazine, all available from the Ex Libris SFX Web site [http://www.sfxit.com/sfx4.html].

Currently, SFX is in beta testing at Los Alamos National Laboratory, Harvard University Library, California Institute of Technology, Vanderbilt University, and Indiana University Purdue University Indianapolis. Additionally, the Institute for Scientific Information (ISI) and Ex Libris have entered a partnership to integrate the Web of Science with SFX link technology. Other primary and secondary publishers are also involved with SFX technology. [For a full list of participants, see http://www.sfxit.com/targets.html and http://www.sfxit.com/sources.html.]

external hyperlinks: Related Articles, Books, and LinkOut. Only the LinkOut link may take the user to the full text of the article. I stress the word *may*. After clicking on the LinkOut link in a record, the user may be offered three other types of external links: a link to a library's holdings (still in beta test), a link to the journal publisher's Web site, or a link to general subject information about the article's topic. The user has the choice of displaying records in several formats, including brief, summary, abstract, and LinkOut. Unless the user chooses to display the records in the LinkOut display, the user will not know whether LinkOut links connect to the journal publisher's Web site or to general subject information.

Users, beware, however. There really is no free lunch. Once at the journal publisher's Web site, full text may or may not be available. Because policies vary by provider and by journal, user registration, a subscription fee, or some other type of fee may be required to retrieve the full text. If the user or the user's organization has a subscription to the journal, access is seamless. If not, other arrangements have to be made for full-text access, such as pay-per-article. There are no standards; it varies from journal provider to journal provider.

Additionally, publishers, aggregators, libraries, and other Web resources can use LinkOut to provide links from PubMed citations to their full-text Web sites or, in the case of a library, their holdings. These institutions provide URLs that point to their Web sites and through a holding file that describes their electronic resources. In this way, publishers, aggregators, libraries, and the like can provide links from PubMed to their Web sites, thus providing an appropriate copy for the user. According to the PubMed Web site, several libraries are currently beta testing this feature, specifically the Houston Academy of Medicine-Texas Medical Center Library, Johns Hopkins University's Welch Medical Library, Lane Medical Library at Stanford University, the NIH

Library, Percy Howe Library at the Forsyth Institute, University of Connecticut/Health Center/L.M. Stowe Library, University of South Alabama's Charles M. Baugh Biomedical Library, and Vanderbilt University's Eskind Biomedical Library.

PubSCIENCE [http://pubsci.osti.gov], a new service developed by the Department of Energy Office of Scientific and Technical Information (DOE OSTI), has become an online service available to the public in partnership with the U.S. Government Printing Office (GPO). The citations in this bibliographic journal citation database come from participating publishers, information intermediaries, and the DOE database maintained by OSTI. Participating publishers include major science and engineering publishers, such as Blackwell Science and Springer-Verlag (LINK). [For a list of participating publishers, visit http://pubsci.osti.gov/collectionsfrm.html.]

Perhaps new services such as OCLC WebExpress are the solution. Or, perhaps digital libraries, with their one gateway approach, are the answer.

PubSCIENCE became available in October of 1999 and is closely modeled after PubMed. Like PubMed, PubSCIENCE provides access to full text via a link to the publisher's Web site. For instance, a bibliographic record provides a link to the journal's Web site. If a user or user's organization has a subscription, access to full text is seamless. If not, other arrangements for full-text access must be made.

DOE offers other services that provide links to the full text of gray (report) literature and preprints or e-prints. The DOE Information Bridge [http://www.osti.gov/bridge/] provides access to more than 50,000 searchable reports, and the PrePRINT Network [http://www.osti.gov/preprint/], a gateway to more than 1,000 preprint servers.

Is Everyone Linked Together?

We are witnessing an explosion of linking agreements among primary and secondary publishers. CrossRef, ElsevierScience, Ovid, SilverPlatter are only the tip of the iceberg. We are also witnessing a stampede to provide the most full text through one interface, whether software or service, internal or external linking.

Reference linking includes moving either internally or externally from a record within a database directly to the primary content. Reference linking also includes moving from a record within a database to the holdings of a particular library, holdings that may be print or electronic. Finally, reference linking includes moving from a citation within an article, such as a footnote or endnote, to its full text. However, the process is more complicated than it may seem at first glance. For instance, very little access to full text is currently free, and access to the full text of articles is often limited by license agreements and subscriptions. Further, without subscription access, users face the daunting complexity of dealing with the decisions each aggregator and/or publisher makes individually in deciding how or whether to grant access.

Perhaps new services such as OCLC WebExpress are the solution. Or, perhaps digital libraries, with their one gateway approach, are the answer. On the other hand, perhaps initiatives such as CrossRef or PubMed Central will solve the problems. Whether it is one of these or a hundred other possibilities, the truth remains that we have unprecedented access to the electronic full text of scholarly journals. The options for full-text access, albeit confusing, are almost endless. *

Footnotes

1 Lee Ketcham-Van Orsdel and Kathleen Born, "Pushing Toward More Affordable Access," *Library Journal*, April 15, 2000, pp. 47-52.

2 Carol Tenopir, "Should We Cancel Print?," *Library Journal*, September 1, 1999, pp. 138-142.

3 The DLFAC report defines reference linking, from a user perspective, as "the ability to get from a citation to the thing cited in a Web environment."

4 More information about this project is available in an article published by the project's creators, William A. Britten et al., "Access to Periodical Holdings Information: Creating Links Between Databases and the Library Catalog," *Library Collections, Acquisitions, & Technical Services*, vol. 24, 2000, pp. 7-20.

5 Walker.

6 The content of these meetings is summarized by several reports and articles, including one by the Digital Library Federation Architecture Committee (DLFAC) in its report, "Choosing the Appropriate Copy" [http://www.niso.org/DLFarch.html] and one by Priscilla Caplan and William Y. Arms in their D-Lib Magazine article, "Reference Linking for Journal Articles" [http://www.dlib.org/dlib/july99/caplan/07caplan.html].

7 Priscilla Caplan and Dale Flecker, Digital Library Federation Architecture Committee, "Choosing the Appropriate Copy," September 1999. Available at http://www.niso.org/DLFarch.html. Accessed 8/5/00.

8 Jenny Walker, "Navigating Information Landscapes: The Role of Linking Technologies and the Need for Standards for Interoperability." Online Conferentie Nederland, April 5, 2000. Available at http://www.sfxit.com/Online2000.doc. Accessed 7/15/00.